

BREEDING ECOLOGY OF ANNANDALE'S TREE FROG *CHIRIXALUS SIMUS* (ANURA: RHACOPHORIDAE) NEAR KOLKATA, WEST BENGAL¹

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(With one plate)

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The breeding ecology of the Annandale's tree frog (*Chirixalus simus*) was studied in a 340 sq. m marsh at Rajpur, West Bengal. The results showed that the species is an early breeder, breeding in the first month of monsoon. Most foam-nests are constructed on grass, in the first two weeks, 6-58 cm above standing water and contain 153-234 eggs. The size of the foam-nests depends on their position on the grass where the frogs mate. The nests are located 10-807 cm away from dry land. It has been speculated that different species of the genus show a preference for land over water for constructing foam-nests.

INTRODUCTION

Chirixalus is a genus of small to medium-sized Old World tree frogs (Anura: Family Rhacophoridae) widely distributed from Japan to India and is known from nine nominal species (Frost 1985). Although there are some accounts on the morphology of the genus, not much is known about the reproductive biology. Most *Chirixalus* species are believed to construct arboreal foam-nests, from which tadpoles drop into ponds and ditches soon after hatching. *Chirixalus nongkhorensis* of Thailand and China constructs foam-nests on the surface of pond water (Duellman and Trueb 1986). *C. idiototocus* of Taiwan lays eggs on land, near the edge of water without making a foam-nest. Hatching is apparently stimulated by rain and tadpoles spend a typical aquatic life in ponds or rain pools (Kuramoto and Wang 1987). Ecological data on the breeding habits of the genus *Chirixalus* is lacking. In this paper, I report the breeding ecology of *Chirixalus simus* during June to September 2000, at a site near Kolkata, West Bengal, India.

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MATERIAL AND METHODS

The study site was located in a marshy area at Rajpur (22° 20' N, 88° 35' E), South 24 Parganas district, West Bengal, 6 km south of Kolkata in September, 1999 (Deuti *et al.* 2000). A plot of 340 sq. m (20 x 17 m) was marked off. The plot has a waterhole of 24 sq. m (6 x 4 m) in one corner with grass (*Saccharum spontaneum*), banana (*Musa paradisiaca*) plantations on two sides, a village road on the third and a high concrete boundary wall of a residential building on the fourth. The plot, including the waterhole, dries up completely during summer, and the grass is cropped short by grazing cattle. With the advent of monsoon, the plot gets waterlogged, the grass grows up to 2 m and flowers. The frogs, which hide in the sheaths of the banana plants during summer, arrive at the plot to feed and breed on the grass, constructing foam-nests.

Throughout the monsoon, from mid-June to mid-September, the plot was visited twice a week and the number of foam-nests, their measurements, distance from dry land, height above ground and water-level, and maximum depth of water in the plot were measured. Daily atmospheric temperature, relative humidity and rainfall data were obtained from the Alipore meteorological station, Kolkata, and the data on

number of foam-nests and depth of water in the plot were tabulated with the weather parameters (Table 1). The mating calls were recorded and photographs of breeding pairs and foam-nests taken. The plot was sampled every three days to allow the foam-nests counted earlier to dissolve and let the tadpoles escape into the water. This prevented re-counting and measuring of the same foam-nests. Some foam-nests were collected during different times of the breeding season to determine the clutch-size.

RESULTS

In 2000, the monsoon commenced a little late in southern West Bengal. There was negligible rain from mid-June to mid-July, the plot remained dry and there was very little water in the waterhole. Only a few individuals of *Hoplobatrachus tigerinus* were heard calling at the plot on June 22, when there was a sudden cloud burst, producing 69 mm of rain, but they could not breed as the rain water quickly seeped into the ground. On July 7, 2-3 male *Polypedates*

maculatus arrived at the plot and started calling, but no females were sighted. The first week of July was dry, without any precipitation. From July 9, it rained daily and by July 11, it was apparent that the monsoon had finally set in. Water started accumulating in the plot from July 12. By July 14 there was 5 cm of water in the plot and the first males of *Chirixalus simus* had arrived and started calling. The first females arrived only on July 16.

On July 17, four pendulous foam-nests were observed on the grass (Table 1). When the water level at the plot increased to 11 cm on July 22, due to substantial rain everyday, the breeding activity of the frogs peaked to 34 foam-nests, gradually decreasing to none by August 18. Due to heavy precipitation each day, the water level increased further to 42 cm and 58 cm on July 24 and July 26 respectively. However, the number of foam-nests decreased to 11 and 6, respectively. As the water level at the plot decreased during the next two weeks to 26 cm by August 13, the frogs constructed fewer numbers of foam-nests. After that as the water-level decreased further to

TABLE I
BREEDING PATTERN OF *CHIRIXALUS SIMUS* AT THE STUDY PLOT

Date of Observation	Max depth of water (cm)	Number of foam-nests	Rainfall on previous day (mm)	Max & Min. temp. on previous day (°C)	Max & Min R.H. on previous day (%)
14.07.2000 (first frog arrived)	5	0	16.0	32.2-25.9	97-75
17.07.2000	6	4	11.1	32.8-27.0	97-73
19.07.2000	8	9	34.6	27.1-24.9	98-74
22.07.2000	11	34	25.7	27.0-26.4	98-85
24.07.2000	42	11	62.8	27.4-24.9	98-76
26.07.2000	58	6	12.4	29.9-25.4	97-76
29.07.2000	39	3	7.0	32.3-26.0	98-69
02.08.2000	33	2	13.0	32.5-25.2	97-75
07.08.2000	28	1	31.7	34.3-27.9	97-72
10.08.2000	30	1	11.3	32.4-27.5	94-73
13.08.2000	26	1	29.9	28.3-26.3	98-92
18.08.2000	23	0	56.3	32.9-26.2	98-79
25.08.2000 (froglets seen on grass)	15	0	0.2	34.0-27.2	94-67
30.08.2000	0	0	0.4	32.4-27.5	95-75
02.09.2000	22	0	20.5	31.8-25.3	98-70
08.09.2000	38	0	11.2	30.0-26.1	98-87
14.09.2000	13	0	0.2	32.4-26.2	97-71



Fig. 1: Foam-nest of *Chirixalus simus*

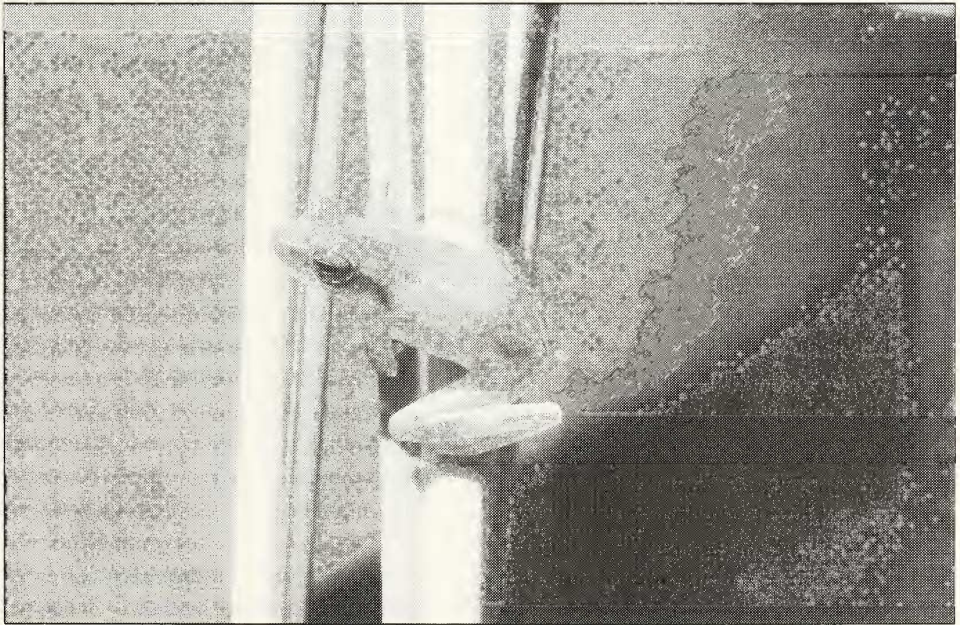


Fig. 2: *Chirixalus simus* at Rajpur, West Bengal

0 cm (no standing water at all) on August 30, there were no more foam-nests. Tiny froglets (snout-vent length: 9 mm) were seen clambering on to the grass on August 25, tadpoles of the first foam-nests had metamorphosed. In September, there was some more rain and the water level at the plot increased to 38 cm on September 8, but though other atmospheric conditions were suitable for breeding, no more foam-nests were constructed. The breeding was over by mid-August, though some males were still calling in the plot till mid-September.

Of the 72 foam-nests observed, 22 were measured. Length of the foam-nests varied from 5.2-7.3 cm (\bar{X} = 6.06, SE = ± 0.15), breadth from 1.9-3.6 cm (\bar{X} = 2.77, SE = ± 0.10) and thickness from 1.6-2.8 cm (\bar{X} = 2.27, SE = ± 0.08). The foam-nests were constructed on grass, 17-89 cm above the land (\bar{X} = 48.61, SE = ± 4.87) and 5-64 cm above the water level (\bar{X} = 31.5, SE = ± 3.91). The depth of the water in the plot ranged from 4-46 cm (\bar{X} = 17.11, SE = ± 2.76). The foam-nests were constructed 10-807 cm from the nearest dry land (\bar{X} = 231.9, SE = ± 35.81). Six foam-nests collected contained 192, 164, 212, 234, 216 and 153 (\bar{X} = 195) eggs.

DISCUSSION

From these observations, it is apparent that *Chirixalus simus* is an early breeder. Breeding activity starts with the arrival of the monsoon and continues for about one month, but most of the breeding and foam-nest construction occurs within the first two weeks. Thereafter, 1-2 foam-nests may be constructed. The frogs exhibit sporadic rain linked breeding (i.e. they breed sporadically after heavy rains). Anurans in tropical areas breed only when the rainfall is sufficient to provide oviposition sites (Duellman and Trueb 1986). In *C. simus*, some rain (11-63 mm) is required to initiate breeding activity, as there must be some standing

water (4-46 cm) at the base of the grass for construction of the foam-nests. It was observed that temperatures of 25-33 °C and relative humidity of 73-98% are required for breeding. The measurements of the foam-nests depend on their position on the grass where the frogs mate and lay eggs. The clutch size varied from 153-234 eggs.

Foam-nest construction has evolved independently in five anuran families: Leptodactylidae, Myobatrachidae, Rhacophoridae, Hylidae (in a few species) and Hyperoliidae (in a single species, *Opisthoxylax immaculatus*). Foam nesting species have evolved from aquatic to terrestrial environments. This route may have been through the evolution of a foam-nest (Heyer 1969) whose main function seems to be that of protecting eggs and larvae against desiccation (Hodl 1986), and thermal damage as white foam reflects heat (Gorzula 1977). In the light of this information, I speculate that the construction of foam-nests in *Chirixalus* has evolved mainly for protection against desiccation and insolation of eggs and embryos. The route from aquatic to terrestrial habitats in the different species of the genus *Chirixalus* has progressed from *C. nongkhorensis* of Thailand which constructs foam-nests on the surface of water, through *C. simus* and *C. dudhwaensis* of India, which construct foam-nests hanging from grass over temporary water to *C. vittatus* of Myanmar and Thailand, which constructs gelatinous foam-nests on the surface of grass blades growing at the edge of water, ultimately to *C. idiotocus* of Taiwan, which lays eggs on land near water without forming a foam-nest.

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BREEDING ECOLOGY OF ANNANDALE'S TREE FROG CHIRIXALUS SIMUS

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